Imaging Data for Hazardous Waste Applications

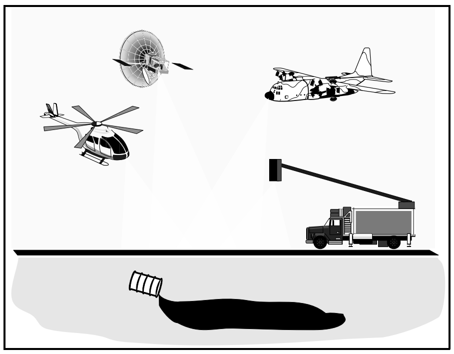
Developer: Environmental Research Institute of Michigan
Contract Number: DE-AR21-95MC32116
Crosscutting Area: CMST

Subsurface Contaminants FOCUS AREA

Problem:

Areas of waste disposal at DOE sites are not all documented and located. There are a number of reasons for this situation: records have been lost or destroyed, the locations were not documented, and memories have been lost. The search of large areas at these sites for buried waste and buried-waste containers is a difficult and expensive problem when using conventional, ground-based methods. Typical conventional methods involve the drilling of wells/boreholes (point sampling), and interpolation is required to obtain the needed areal information. Drilling is expensive, potentially hazardous, and time-consuming, yet accurate interpolation can require a large number of holes per-unit-area. A similar problem is encountered in gaining current information about: the boundaries of toxic waste plumes in the ground, transport pathways, and the composition and concentration of toxic materials.

With drilling operations costing hundreds of thousands of dollars per hole, the reduction in the number of holes is of great economic concern. Equally, important, safety must be a principal consideration when drilling to explore for unknown buried waste. Consequently, alternatives to conventional ground-based methods should be evaluated.



Solution:

Remote sensing (multispectral, radar and infrared, together with aerial photography and airborne nuclear detection) is a technology that is well-suited to the surveillance of large areas for detecting and locating buried objects, and for mapping seepage from buried containers and the boundaries of toxic plumes. Remote sensing also may provide spatially continuous information to achieve the accurate interpolation of point-sampled data.

Benefits:

- Economy: Rather than (or in conjunction with) statistical methods, analysis of remotely sensed data will provide information on where waste is located and on where wells should be drilled in order to obtain definitive characterization of waste sites. This would reduce the expense of exploratory drilling and the necessity for fine-gridded sampling.

- Accuracy: Remote sensing's capability to provide (relatively) continuous information would be used to extrapolate conditions between wells/boreholes. This would improve the accuracy of information derived from point-sampling, and also would provide better data for waste-flow models.

- Safety: In many situations there are risks associated with inadvertently drilling into containers and in working in areas where hazardous waste has migrated to the surface. Such conditions may not be known beforehand. Remote sensing provides the capability to detect and map such hazardous areas prior to beginning clean-up and mitigation.

Technology:

Algorithms have already been developed and tested in the DOD and intelligence communities that can be applied to solving DOE waste problems. Many of those sites have archival data available for analysis which include aerial photography, multispectral and infrared imagery, radar imagery, and nuclear radiometry.

Image processing and data-integration algorithms have been developed and validated under funding by defense and intelligence organizations. They have been applied to the detection of buried objects, vegetation stress, soil moisture and liquid migration, and change detection. The algorithms are based upon phenomenology that is also relevant to the detection, mapping, and monitoring of waste materials. These algorithms have been integrated into a methodology for waste detection and characterization at DOE sites.

The Los Alamos National Laboratory (LANL) is the test facility for the project.

Project Conclusion:

This project was concluded in January 1996 after successfully completing contractual objectives. ERIM gathered, collated, interpreted and analyzed existing aerial and satellite imagery, including classified data, of a number of specific waste sites within LANL. ERIM and LANL worked together to select six sites containing buried waste for the study. The objective was to detect and characterize buried trenches containing contaminants, seepage from capped areas and old drain fields, and to delineate strata for soil sampling. Pre-existing aerial multi spectral Daedalus data, Systeme Pour l'Observation de la Terre (SPOT) satellite imagery, aerial photography, digital map information, and engineering drawings were used in the study.

Results of the effort were the following: delineation of old trench and septic field boundaries; analysis of thermal signatures of unusual geologic strata, asphalt, and buried pits; analysis of fault and fracture areas beneath contaminated areas; comparison of existing engineering drawings of buried objects with imagery interpretation; and use of hydrologic data merged with imagery to aid soil sampling strategies. The findings of the study are being used by LANL in their site remediation efforts.

Contacts:

The Environmental Research Institute of Michigan is a non-profit research corporation specializing in sensor technology, remote sensing, and image processing for defense and environmental sponsors. For information on this project, the contractor contact is:

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DOE's Morgantown Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

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